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The Lessons of Complexity and Future Warfare

**A Monograph
by
MAJ Kevin D. Hendricks
United States Army**



**School of Advanced Military Studies
United States Army Command and General Staff College
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Abstract

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Thesis: The examination of land warfare within the conceptual framework of complex adaptive system (CAS) theory and fourth generation war (4GW) theory offers a unique perspective and provides valuable insight into optimal capabilities and characteristics for the future military force.

Discussion: The traditional views on military conflict have begun to change. Warfare is now best described as a clash between complex adaptive systems. Doctrinal publications are turning away from the linear Newtonian view and instead are using new science metaphors to describe the methods and conduct of war. The new science of CAS describes warfare in biological rather than mechanistic terms. Professor John H. Holland of the University of Michigan developed a universal theory for complex adaptive systems that provides the foundation for this investigation into CAS. Dr. Andrew Ilachinski at the Center for Naval Analyses (CNA) provides the relevance of complex adaptive systems to land warfare in his work to model land combat as a complex adaptive system. A distillation of their work identifies the optimal capabilities and characteristics for operating within the complex adaptive system of the modern battlefield.

The methods of waging warfare are changing on these modern complex battlefields. The fundamental nature of warfare has not changed, but changes in the methods and conduct of warfare appear to be shifting. A new future vision of warfare appeared this past decade in a number of books, professional journals and presentations, including an article titled "The Changing Face of War: Into the Fourth Generation" by William S. Lind and others. The possible emergence of a new generation of warfare sparked interest in the changing trends of the modern world and their implications on the future of warfare. Emphasis in the past has always been towards large, identifiable foes with professional standing armies. Fourth Generation Warfare (4GW) reorients the military toward a new kind of threat, similar to our opponents in the war on terrorism. This reorientation identifies capabilities and characteristics optimal in a military faced with the task of operating against new methods of waging war and multiple hybrid opponents of the modern environment.

Conclusions: The concepts of complex adaptive systems theory provide solutions for improved success in modern land combat and fundamentally increasing our general understanding of the basic processes of war at all levels. The new science of complexity provides much more than answers to old the questions, but rather an entirely new set of questions pertaining to operations on the battlefield. 4GW suggests that as nation-states shift from the old Westphalian model to some newer derivation, we will encounter increasingly chaotic forms of opposition. The result of this shift will be the requirement to wage war effectively against emerging non-state actors employing new methods for which the current military must adapt to overcome. The U.S. military has already identified most of the optimal capabilities found in this study and is addressing each the future visions of 2020. The question remains if the vision will become reality.

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Introduction

The conduct and methods of waging warfare are changing. Conventional linear thinking is not sufficient to cope with the challenges of tomorrow. The scientific community is intrigued by the ideas of complexity theory put forward in Chaos by James Gleick, Complexity by Mitchell Waldrop and Hidden Order by John Holland. Before complexity theory emerged, scientists relied upon the conceptual framework of Newtonian determinism that suggests that initial locations and velocities of masses uniquely determine all their future states.¹ This classic framework is quantitative in nature, isolates system components and uses linear approximations to describe complex behaviors. The obvious limitation of this framework is the real world cannot be quantified, isolated, or precisely measured. The result is unpredictability in accurate weather forecasting, inexplicable market crashes and the collapse of prosperous economies. The same holds true for an accurate prediction of the causes and outcomes in war.

In the 1980's, the birth of the new science of Complexity provided a conceptual framework of understanding how complex systems are capable of generating simple patterns and simple systems are capable of displaying complex behaviors. Military professionals such as John Boyd and others realized that land warfare had very much in common with these other complex systems. This is evidenced by the relevance of similar behavior in complex adaptive systems to that of the battlefield where small initial changes can produce significantly large outcomes. The lessons learned in other complex systems might be applied as leverage points in land warfare.

Along with the discovery of complexity, military thinkers realized that the swirling interactions and changes occurring in the modern world have produced changes in the methods of conducting warfare. Historian Martin Van Creveld first published this idea in Transformation of War.² Then more articles began to appear including, "The Changing Face of War: Into the Fourth

¹ Briggs, John and F. David Peat. *Turbulent Mirror*. New York: Harper and Row, Publishers, Inc., 1989.

² Van Creveld, Martin. *Transformation of War*. Cambridge: Harvard University Press, 1985.

Generation” by William S. Lind and others that advocated major shifts in military doctrine for the military. The idea was that rapid advances in technology, changes in cultural boundaries and subtle shifts in society had profound effects on warfare. However, what was misunderstood in the excitement of the discovery was that the conduct of warfare was indeed changing, but not the nature of war.³

This paper analyzes each of these discoveries and then examines the implications upon the future of land warfare. The initial chapter explains the new science of complexity and examines its relevance to land warfare. The following chapter then outlines the most critical capabilities and characteristic for optimization within the complex environment of land warfare. The third chapter examines the trends and causes of the changes in the methods warfare. From this examination, a future threat spectrum is created to focus the optimal military capabilities for the future. These capabilities are identified in the fourth chapter, with the understanding that optimization is more about synergy than ability. The last chapter examines possible recommendations for leveraging the current strengths of the military with the knowledge gained through the study of complexity and current trends to optimize the military to excel in any future land combat.

The result is a discovery of the richness of opportunities available in the interaction of these global changes in relation to the variables involved in the conduct of warfare at the operational level. The ability to understand and excel in these complex future generations of warfare must be the foremost military competency of the next century. The Revolution in Military Affairs (RMA) may simply be the attainment of this crucial awareness.

³ Dubik, James M. MG, USA. “Has Warfare Changed? Sorting Apples from Oranges” AUSA Institute of Land Warfare: Landpower Essay. No. 02-3, July, 2002: 1-2.

Chapter One - Complexity and Land Warfare

The idea of complexity is relatively simple – a complex adaptive system is much more than a simple sum of its parts. For the military, this means success demands a focus on effects and influence, rather than prediction and control. Unfortunately, because complexity requires a quantification of what is more of a qualitative measure, it is an extremely difficult concept to define.⁴ Thomas Czerwinski claims that complexity is a reflection of the true science of the Information Age.⁵ A complex system displays seemingly chaotic and unpredictable behavior, but is governed by dynamic aggregate behavior. These characteristics make traditional scientific tools of trend analysis, determination and sample means inadequate to explain real world phenomena and therefore render the Lanchesterian models obsolete in predicting the outcome of battles.

In the past, basic “Lanchester” equations modeled the outcome of battles as a function of force ratios, focusing on losses and the attrition of forces only.⁶ In the past a planner asked, “What are the consequences of my plan?” Whereas the newer non-linear approach of complexity advocates objectively charting out the implications and interactions of all possible options by asking the question, “What is the effect and consequence of my actions on the enemy in each of the possible options?”⁷

Complexity is usually greatest in systems when the outcome is difficult to predict from its initial state, or whose components are arranged in an intricate pattern. Therefore, complexity generally falls into one of two general classes: Behavioral Complexity- referring to the complexity of actual behavioral patterns exhibited by complex, or simple systems (i.e.

⁴Gell-Mann, Murray. *The Quark and the Jaguar: Adventures in the Simple and the Complex*. New York: W.H. Freeman and Co., 1994: 16-19.

⁵ Czerwinski, Thomas. *Coping with the Bounds: Speculations on Non-linearity in Military Affairs*. Washington DC: National Defense University Press, 1998. [online] <http://www.dodccrp.org/coptin.htm> last accessed 12 Nov 02.

⁶ Ilachinski, Part II, 50-61.

⁷ Ibid

deterministic chaos), and System complexity-referring to the structural, or organizational, complexity of a system (i.e.- interacting molecules in a fluid).⁸ Looking at land warfare through this new lens requires us to redefine the conventions by which military conflicts have traditionally been viewed. Traditional wisdom views combat as a collision between two billiard balls obeying the linear laws of Newtonian physics. Through the new lens of complexity, it is better perceived as an evolving activity between two interacting fluids of self-organized hierarchies.⁹ Patterns emerge from this evolving activity that emphasize survival. In the effort for survival locally unanticipated emergent behavior emerges.

Unfortunately, as a direct result of our genetic make-up, education, culture, society and experiences throughout life, humans tend to think very linearly. This is a result of the dominant "Newtonian" philosophy introduced by Isaac Newton to describe nature. Newtonian understanding is based on the arrangement of nature as a linear phenomenon where inputs are proportional to outputs; careful planning result in reliable predictions; and reductionist processes are placed as a premium in gaining results. The breaking down of large, complex problems into smaller, manageable pieces is the fundamental nature of this linear reductionism. Complexity is post-Newtonian in the understanding that the world around us, including warfare, operates in a non-linear fashion where inputs and outputs are not proportional and events are unpredictable.¹⁰ Complexity scientist, Mitchell Waldrop explains the reality of operating in a complex system:

"...new opportunities are always being created by a system. And that, in turn, means that it's essentially meaningless to talk about a complex adaptive system being in equilibrium; the system can never get there...the most they can ever do is to change and improve themselves relative to what the other agents are doing."¹¹

⁸ Ilachinski, Andrew. *Land Warfare and Complexity, Part II: An Assessment of the Applicability of Nonlinear Dynamic and Complex Systems Theory to the Study of Land Warfare*. Alexandria, VA: Center for Naval Analyses, 1997: 50-61.

⁹ Kauffman, Stuart. *At Home in the Universe: The Search for Laws of Self-Organization and Complexity*. Cambridge: Oxford University Press, 1995: 4-67.

¹⁰ Czerwinski, Thomas. "Coping with the Bounds: Speculations on Non-linearity in Military Affairs" and John Briggs & F. David Peat's, *Turbulent Mirror* which explain these concepts in language understandable to the average individual.

¹¹ Mitchell M. Waldrop. *Complexity: The Emerging Science at the Edge of Order and Chaos*. New York: Simon and Schuster, 1992: 99.

One basic truth derived from this general understanding of the basic concepts of complexity is that success will likely go to those that excel in adapting to uncertainty. The bottom line for the military is that efforts must focus on effects and influence, rather than prediction and control.

Basics of Complex Adaptive Systems

A complex adaptive system contains seven basic attributes as described by John Holland¹² and are the product of an agent's adaptive interactions.¹³

- **Nonlinearity:** All complex adaptive systems involve large numbers of parts undergoing a kaleidoscopic array of simultaneous nonlinear interactions.
- **Aggregation:** The collective interaction between individual agents results in an aggregate behavior not found in any one part. In fact, the aggregate behavior often feeds back to the individual parts, modifying the behavior of the whole.
- **Flows:** Flows represent a process where resources are transmitted from node to node through a connector. An example of this (node, connector, resource) relationship in the military exists in (C2 sites, radio nets, information).
- **Diversity:** The system requires a continuously changing, wide variety of agents to meet the needs of the system. The longevity of any agent depends on the context of the environment provided by the other agents. It is important to note that this diversity is not random.
- **Tags:** Tagging allows agents to form aggregates. Tags are used to manipulate symmetries, allowing agents to ignore certain details while directing our attention to others. The perfect example of a tag would be the unit patch of a military organization.
- **Internal Models:** Agents develop internal models of their environment in the effort to adapt to changing circumstances. These models allow agents to anticipate the response of their environment. A key aspect of understanding the adaptive process is the effectiveness of recognizing patterns associated with these models.
- **Building Blocks:** Building blocks provide models with consistency in a perpetually changing environment. Building blocks aid in the formation of useful models by providing familiar information from previous experience to confront novel situations.

¹² John H. Holland. *Hidden Order: How Adaptation Builds Complexity*. New York: Addison-Wesley Publishing Co., 1995: 10.

¹³ An agent is the generic label used to describe the fundamental actors or individuals within a complex system. One of the "agents" within the complex adaptive system of land warfare would be the individual soldier or weapon system.

These properties define the general behavior of complex adaptive systems, and the mechanisms facilitating their interaction. Agents formed by aggregation are a central feature, typified by units ranging from mechanized and armor divisions to Special Forces teams or supply units. These other agents determine virtually every combat event in the area, so that at one level of abstraction the complex adaptive system that is the battlefield is well described by the evolving interactions of these agents. We have only to look to unit missions, uniforms and weapon systems to see how tags facilitate and direct these interactions. The diversity of these tags underscores the variety in the battlefield actors and activities, and the complex flow of information into, out of and throughout the battlefield that results. That the battlefield retains both a short-term and a long-term coherence, despite diversity, change and lack of central direction, is typical of the emergent behavior of complex adaptive systems.

Non-linearity lies near the center of battlefield complexity and is embedded in the internal models that drive a leader's decision-making abilities. These models range from individual concepts to sophisticated division level plans. There are also continual innovations, such as the steady flux of tactics and weapon systems on the battlefield. Trend projection and other linear analyses provide few insights into these activities. New perceptions will surface, if we can uncover the building blocks that are combined and recombined to determine each battle's outward appearance. The building blocks for land warfare are less obvious than for some other complex systems though past battles, other armies, terrain and weather, mission statements, and weapon systems are all obvious candidates.¹⁴

In his work at the Center for Naval Analysis, Dr. Andrew Ilachinski identifies the relevance of the study of complex systems to that of land warfare.

¹⁴ This paragraph applies the same framework used by John Holland in *Hidden Order: How Adaptation Builds Complexity*, 13-40 and paraphrased by Thomas Czerwinski in *Coping with the Bounds* to describe the city of New York with each of the properties and mechanisms as a Complex Adaptive System. However, it significantly differs in the idea that the same concept can be used to describe a modern battlefield as a complex adaptive system.

“...significant new insights into the fundamental processes of land warfare can be obtained by viewing land warfare as a complex adaptive system... by viewing a military "conflict" as a nonlinear dynamical system composed of many interacting semi-autonomous and hierarchically organized agents continuously adapting to a changing environment.”¹⁵

From this study, significant relevant relationships have been discovered between complexity and land warfare. First, each agent is actually an autonomous entity sensing and acting upon its environment. In doing so, it attempts to fulfill a set of goals by using sensors to understand its environment and then act upon the environment through actuators. Secondly, it is much less important to understand what parts are composed of and what those parts do compared to how those parts are interconnected in a complex system. Thirdly, the most successful systems are those that exist in ‘far-from-equilibrium’ states and are continually seeking new ways to adapt to their environment.¹⁶ Fourth, is that a system may "solve" a given problem in many different ways, because it is not composed of the blind billiard balls accepted in Newtonian logic. Instead, it is composed of a diversified mixture of agents capable of sensing, learning from and adapting to their environment. This lesson coincides with the observations of Eliot A. Cohen and John Gooch that the reason for many military misfortunes is the failure of armies to anticipate, learn and adapt, largely due to their linear orientation.¹⁷ Fifth, a central concept of complex systems theory is that high-level behaviors naturally emerges out of the twisting, boiling mixture of many nonlinearly interacting parts at a very low level. For example, an auditorium full of people in the experiments by Loren Carpenter or a flock of computer generated birds, referred to, as “boids” in Craig Reynolds computer simulation do not need any central direction to behave in an apparently

¹⁵ Ilachinski, Andrew. *Land Warfare and Complexity, Part I: An Assessment of the Applicability of Nonlinear Dynamic and Complex Systems Theory to the Study of Land Warfare*. Alexandria, VA: Center for Naval Analyses, 1996: 6-9.

¹⁶ Ilachinski, Part II: 22.

¹⁷ Cohen, Eliot A. and John Gooch. *Military Misfortunes*. New York: The Free Press, 1990: 59-164, 229-230, 233-243. A complete understanding of this concept requires a complete reading of the entire work by these two intellectuals. Additionally, the reading of the excellent book by Dietrich Dorner. *The Logic of Failure* nicely complements these ideas and concepts

orchestrated manner.¹⁸ Sixth, knowledge of an agent's genotype, the actual genetic constitution of an organism, does not in any way explain an agent's phenotype, the observable characteristics and properties of the agent. In other words, perfectly understanding the underlying makeup of an agent does not produce an even vague notion of the likely behavior of the agent.¹⁹ Seventh, nonlinear systems are much more pervasive than linear systems, because without non-linear interactions there can be no deterministic chaos in simple systems and no complex behavior in complex systems. Eighth, self-organization is a fundamental characteristic of all complex systems. It is a result of the interactions of the individual agents within a complex system reacting and adapting to the environment from which emerges a macroscopic-level, organized structure of non-equilibrium. This is similar in concept to the "Swarm" or "Hive" studies introduced by one of the original founders of complexity theory, Stuart Kaufman.²⁰ Ninth, the effects that parts have on the system is determined by the context of the whole within which those parts exist. In referring to any part of a complex system, one must also look to various other parts in which interaction have occurred or may in the future.²¹ Tenth, most global order arises from local activity and this global order affects local dynamics. The complex patterns observed at the higher level are usually the result of relatively simple dynamics at a much lower level, and these very same higher-level patterns have an amazing effect upon local small level agents. An effective illustration is water boiling to visualize the convective rolls of a liquid heated from below and cooled from above. This is a higher dimensional system composed of millions of interacting water molecules seemingly able to act in any chaotic pattern, but instead something

¹⁸ Excellent examples of this phenomenon are vividly illustrated by Kelly, Kevin. *Out of Control*, 5-28 and the actual concept of "Boids" used in the text is explained quite well by Ilachinski, Part I, 66-73 with a background reading of the original article by C. Reynolds. "Flocks, herds, and schools: a distributed behavioral model." *Computer Graphics*. Vol. 21, July, 1987.

¹⁹ Ilachinski, Part II: 139.

²⁰ Kelly, Kevin. *Out of Control: The New Biology of Machines, Social Systems, and the Economic World*. Cambridge: Perseus Books, 1994: 306-311, 389-403. With an additional background reading of Stuart Kauffman's article "Anti-Chaos and Adaptation." *Scientific American*. August, 1991.

²¹ Ilachinski, Part I: 11

unusual occurs - the water rolls as a whole.²² Eleventh, a complex system manifests itself as an endless search for the best solution to a nebulous problem that constantly shifts and moves away to be searched for again. Therefore, a paradigm shift in thinking must accept that there is no such thing as "the solution," because the problem continually changes. A complex system is about process and evolution instead of a "solution." Twelfth, complex systems deal with not just one agent adapting to a given set of circumstance, but many adapting, interacting and evolving that really make up the environment. This concept known as co-adaptation or co-evolution refers to the mutually selective forces acting on entire groups to accumulate favorably interacting elements in the environment.²³ Lastly, a global order emerges without any need for external control. As Dr. Ilachinski puts it, "there is no God-like Oracle dictating what each and every part ought to be doing." Spontaneous appearance of order in a complex system is normally due to the individual agents acting locally on local information.

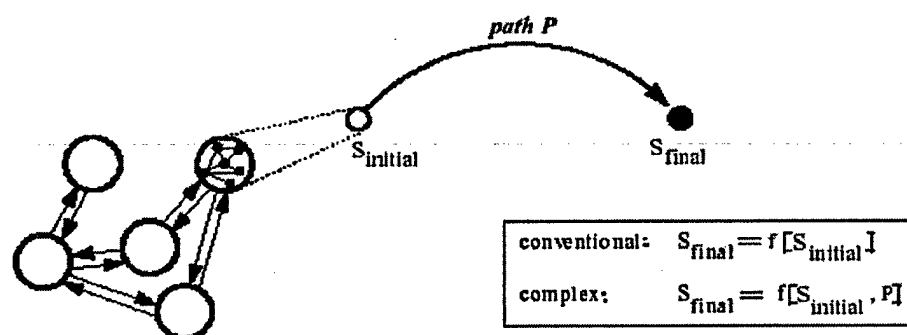


Figure 1 – Complexity Theory²⁴

A visual picture of these differences between complexity and linearity helps to illustrate the importance of these distinctions. The figure shows how the final disposition of an element (S_{final}) in a linear sense is solely a function of its initial state $f[S_{initial}]$. On the other hand, in complexity theory the actual journey along path (P) may, and likely does, have a significant

²² Ilachinski, Part II: 140.

²³ Kelly: 69-90 and Ilachinski, Part II: 137-138.

²⁴ Ilachinski, Part I: 14.

impact upon the final state. This is due to the interaction of the element (S) with its environment, including other elements, along with the actual impact of this journey on the system. To consider one element of reality as if it is in isolation, as is the case in linear reductionism, is to create a false reality.²⁵

Relevance of Complexity to Land Warfare

Dr Ilachinski's research brings the relevance of these concepts into a military perspective in his research to discover the common features of complex adaptive systems, such as predator-prey relationships of natural ecologies; the economic dynamics of world markets; the chaotic dynamics of global weather patterns; the firing patterns of neurons in a human brain and the competing strategies of a nation's political infrastructure.²⁶ He illustrates the relevance of this study of complexity by drawing parallels to the modern battlefield.

"The human brain is composed of about ten billion neurons, each of which, on average, is connected to about a thousand other neurons. What each neuron does is a complicated function of what it did before and what its thousand or so neighbors were doing. Somehow, mysteriously, for reasons that are still not quite clear and perhaps never will be fully, this cauldron of ceaseless neuro-chemical activity spawns something called "consciousness" that emerges on a much higher level than the one on which any of the brain's constituent parts themselves live. Nowhere is there a prescription for an "awareness of self." As such, the human brain is the prototypical example of a complex system, or a system composed of many nonlinearly interacting parts. Now, what happens on a battlefield? While no battlefield can possibly consist of as many combatants as there are neurons in a human brain, the analogy between what makes the human brain "interesting" and what makes that which happens on a battlefield "complicated" is not such a poor one. Both consist of a large number of nonlinearly interacting parts whose individual behavior depends on the action and pattern of behavior of other (nearby and not-so-nearby) parts, both obey a decentralized control, both appear to be locally "chaotic" but harbor long-range order, both tend not to dwell for long times near equilibrium, preferring instead to exist almost exclusively in a nonequilibrium state, and both must continually adapt to internal and external pressures and to the environment."²⁷

²⁵ Briggs, John and F. David Peat. *Turbulent Mirror*. New York: Harper and Row, 1989: 21-29.

²⁶ Ilachinski, Part I: 9, 93, 200 and Part II: 12, 20, 51.

²⁷ Ibid

With this analogy in mind, we can consider that all complex systems have a certain relevance to land warfare.

Generic Property of Complex Systems	Description of Relevance to Land Combat
<i>Nonlinear Interaction</i>	Combat forces composed of a large number of nonlinearly interacting parts -- feedback in C2 loops, interpretation (and adaptation to) enemy actions, decision-making process, elements of chance
<i>Nonreductionist</i>	The overall "fighting ability" of combat force is not a simple aggregate of fighting ability of individual combatants
<i>Hierarchical Structure</i>	Combat forces organized in a command and control hierarchy
<i>Decentralized Control</i>	There is no master "Oracle" dictating the actions of each and every combatant
<i>Self-Organization</i>	Local action, which often appears "chaotic," induces long-range order
<i>Nonequilibrium Order</i>	Military conflicts, by their nature, proceed far from equilibrium
<i>Adaptation</i>	In order to survive, combat forces must continually adapt to a changing environment
<i>Collectivist Dynamics</i>	There is a continual feedback between the behavior of (low-level) combatants and the (high-level) command structure

Figure 2 – Relevance of Complex Adaptive Systems to Land Warfare²⁸

To begin, complex systems consist of a large group of interconnected and nonlinearly interacting parts and that universal behavior stems from this interaction. Basically, a system's complexity is attributable to the fact it consists not just of individuals, but elements whose states continually change as a function of the continual changes undergone by others to which they are connected. In land warfare the complexity of and the outcome of the battle is not based on an individual or a single units action, but rather the interaction of all of these agents within the system. Second, complex systems seem to be organized hierarchically. The interactions of these hierarchical agents at various levels create complex behavior. This hierarchy is prominent in the military structure, but also in the natural world or the universe. This allows the individual agents, or combatants, to form into groups of agents, who in turn form into larger groups commonly referred to as meta-agents, just as soldiers form squads, platoon, company's on up to corps' and armies. However, all agents within the hierarchy are driven by two opposing principles. One

²⁸ Ilachinski, Part II: 3

tells the agent to function as part of the group, while the other pushes it toward its own individual autonomy. This tension is illustrated in a soldier's desire to preserve his own life and the need to sacrifice his life for the sake of the group effort.²⁹ Third, complex systems tend to self-organize according to decentralized control, despite the fact there is not a master agent dictating every action. For example, a soldier may know what his responsibilities are to achieve his mission, but how he reacts and acts in every instance is not whispered in his ear by some superior authority. This self-organization takes place as a system reacts and adapts to its external environment, as parts act locally on local information and global order emerges without any need for external control. According to complexity theorists, "contrary to our deepest intuitions, massively disordered systems can spontaneously 'crystallize' a very high degree of order."³⁰ Fourth, universal behavior of the system is emergent. In other words, the behavior of the group is not possessed by any of the individual agents, yet the group behaves in a particular manner. For example, water molecules are not a wave, or the neurons in the brain do not represent conscious.³¹ Fifth, behavior over the long-term typically consists of nonequilibrium order in which a structure remains stable over an extended period despite the flow in and out of elements of the structure. As seen in most any historical battle in which the engagements never exist in a state of equilibrium. Next, the importance of a given agent or soldier, is dictated more by how he interacts with the whole and what his participation adds to the whole as part of the whole, than by what he represents individually. The interaction of an individual soldier or unit to the group is more important to him than what he physically brings to the fight. In other words, a system cannot be understood simply by decomposition because the critical dynamics of the system are lost in the process, thereby nullifying the value of the study. Reductionist methods which are top-down analysis, or synthesis methods which is bottom-up analysis, cannot be used to understand

²⁹ Ilachinski, Part II: 9-13.

³⁰ Kauffman, Stuart. *Origins of Order: Self-Organization and Selection in Evolution*. Oxford University Press, 1993: 1-45.

³¹ Ilachinski, Part II: 11.

complex behavior. Instead a holistic approach known as the collectivist approach, examines the system in it's entirety in order to retain those crucial dynamic interactions. The lifeblood of a dynamic complex system is really this flow of information between the various agents and the hierarchical levels of the structure.

A complex system is best understood by seeing it as an entity in constant adaptive evolution. A snapshot in time of the system is no better than the examination of a piece of the system, because of the constant adaptation of the system to itself and the environment in which it exists. The value of a holistic study of complex systems in the long term is the patterns observed throughout the course of its evolution. An army including soldiers and leaders must constantly adapt to a situation from moment to moment, because a battlefield is dynamic and constantly evolving.

Chapter Two - Optimal Capabilities in Complexity

Possession by an army of optimal characteristics provide a distinct advantage over an opponent that does not realize the complex environment in which it is fighting nor those capabilities that provide U.S. land forces their overwhelming advantage. Armies throughout the ages have identified many of these characteristics in a piecemeal fashion without a unifying theory for understanding why they were important for success. What is proposed below are the critical capabilities and characteristics the land forces of the U.S. military must possess, based on a better understanding of complexity, for optimal success on a complex battlefield of the future.

The most important capability in a complex environment is adaptability. To possess this trait means rapid transition in thought processes and actions to match the ever-changing environment of a complex system. The hallmark of a complex adaptive system is that, the system itself is always shifting and adapting to accommodate the changes and incongruencies created by the actions of each individual element of the system. Each of these individual elements is in turn a complex system of systems adapting to previous shifts by the system, thereby triggering reciprocal shifts in change that result in a continual loop of change with no possible state of equilibrium. The shifting and changing of a complex system never ends, never stays the same, and most importantly, the more you try to control it the more it will control you. The complexity of the battlefield is even greater than other complex systems because of the simply introduction of a hostile enemy. Clausewitz identified this uniqueness of the military battlefield with his statement:

“...war is not an exercise of the will directed at inanimate matter, as in the case with the mechanical arts, or at matter which is animate but passive and yielding as in the case with the human mind and emotion in the fine arts. In war, the will is directed at an animate object that reacts”³²

On the battlefield, combat forces are fighting against an enemy who is simultaneously adapting within the same complex system and doing so in a way that exploits his strengths against

³² Clausewitz: 149.

your perceived weaknesses. Adaptability allows for the possibility that a previously successful action may now be the worst possible choice, and accommodates the discovery or rediscovery of the best solution despite historic proof to the contrary.

Inherent with the capability to be adaptive is the critical requirement of flexibility in order to change or "flex" actions or thoughts into something new, or even back into something old. Flexibility implies the ability to bend without breaking, stretch without ripping, and twist without tearing. However, flexibility must go hand in hand with versatility, which implies the ability to have multiple functions that are applicable to a variety of situations. Versatility allows multiple options from which to choose from in order to model adaptive actions upon.³³

Given that all complex systems are non-linear in nature and that the battlefield functions in a non-linear state, it would be nonsensical to think in any other way. The rules of non-linearity govern the world much more so than the reductionist principles of linear thought encompassed in most Newtonian science. To effectively tackle complex problems at the operational and tactical level, requires the predominance of non-linear thinking and action instead of relying solely on the limited nature of linearity.

Decentralized control enables a Unit of Action (UA) to operate much more effectively in a complex environment. Decentralized control does not imply the absence of control. Instead, it implies a structure that allows subordinates - soldiers, leaders and units - to receive guidance and direction by superiors to achieve a particular effect or vision, then be given the independence to succeed within the intent of their commander's guidance. It also does not imply the inability of the superior to closely monitor the action of subordinates, nor prevent the adjustment of imprudent actions if necessary in order to meet the higher intent. Decentralization allows a fighting unit the ability to utilize initiative to adapt seamlessly to the environment without having to work through layers of decision-makers for approval. This capability closely mirrors the

³³ Sullivan, Gordon R. "Leadership, Versatility and all that Jazz." *Military Review*. August, 1994: 5-13.

philosophy of "Auftragstaktik", which is espoused by some militaries but not always followed in the true sense of the word. In a complex battlefield, dictating the actions of every element results in time delays and sluggishness. The adaptive nature of a complex system represented on the battlefield may significantly change during a delay and require a wholly different response.

An intrinsic quality of successful decentralization is the trust between senior and subordinate. The senior must trust the subordinate to do the right thing in the absence of guidance; the subordinate must trust that the superior will support his actions and mistakes. Trust grows out of professional bonding between a senior and subordinate. The bond establishes a unique understanding of the others thoughts, actions and intent at a level deeper than normal, and may even be considered subconscious. This climate of command is achieved through tough training and extended exposure to one another under difficult and demanding conditions in which the true nature of the person and unit is laid bare for the other to examine and understanding.

Complexity requires certain specialization to fill required niches within the system. The system necessitates that certain roles and niches be filled, and in order for a given an agent or unit to fill a niche it must possess a particular capability. Without the required capability that serves a useful role in the system, an agent is either marginalized or eliminated by the system. Contingent on the validity of its claim of relevance, the agent will continue to occupy its place in the system. However, the validity of this claim may quickly change if the required capability cannot be adequately provided for by the agent, a better agent arrives to fill the role, or the system itself adapts to a changing environment and eliminates the niche altogether. A successful agent must therefore, be able to maintain relevance to the requirements of the systemic environment.

Units need to be composed of cohesive teams of individuals with diverse competencies, yet harmonized to create a strongly bonded group. Cohesive groups of individuals can function better as one, a concept similar to the strength inherent in a compound alloy. This cohesiveness is the mortar between the blocks of "teams of teams," similar to the meta-agents of complex systems, but in this case created purposefully to emerge with special characteristics instead of

settling for the random product of the natural process. This is an important characteristic within a complex system because of the need for aggregation to occur to create and hold these strong teams together under the strain of combat. The catalyst for this bonding and cohesiveness is the same as discussed in the creation of trust between senior and subordinates. In many ways, the two go hand in hand because trust is the glue that binds people together. The bonding process of an epoxy resin compound requires the combining of two or more elements, which separately are meaningless, but mixed together with the introduction of heat and pressure creates an unbreakable bond. The mixing is the shared experience of being together; the heat and pressure occurs in demanding and realistic training under difficult circumstances. This bonding process naturally occurs in veteran combat units and is well documented throughout history.³⁴

The capability of semi-autonomous action that is independent of other units and especially higher support structures is critical in units operating in complex environments. In the cognitive sense, it implies the ability by units to make independent decisions without guidance or assistance of higher headquarters similar to the idea of decentralization. This emphasizes the independence of the units to operate and survive for a designated period without significant outside assistance, support or sustainment. This eliminates the linearity of the normal logistics tail attached to operational units and provides the desired flexibility to employ units throughout the battle space. In complex systems that rapidly change, every element on the battlefield must be capable of taking care of itself, to a certain degree, especially if the situation shifts rapidly. Consider the possibility on a battlefield where an operational planner anticipated certain actions by the enemy. However, the enemy, as Clausewitz noted, is not an inanimate object. Nor, is he operating within a static, unchanging battlefield system. Therefore, many of the planning assumptions may prove drastically wrong. A force that was not expected to be isolated now finds

³⁴ Kellett, Anthony. *Combat Motivation: The Behavior of Soldiers in Battle*. Boston, MA: Nijhoff Publishing, 1982: 3-5, 41-46, 231-312, 319-333. Additional evidence of the bonding and cohesiveness within units that is created by the shared experience of combat is documented in Richard Holmes in his book *Acts of War: The Behavior of Men in Battle*. New York: The Free Press, 1985 and S.L.A. Marshal's book *Men against Fire*.

itself in that very situation because the operational commander has been forced to divert assets in an effort to adapt to the new unanticipated circumstances. The feasibility of this decision by the operational commander is possible given the semi-autonomy of the operational forces under his command. He can be comfortable in the ability of each of his subordinate units to operate semi-autonomously for a certain period time.

A fluid command structure in which the number and size of units assigned to a parent organization may vary radically between and during operations enhances the capability of the military in complex environments. Consequently, these parent units, synonymous with the meta-agents in complex system theory, will likely never be identical to one another. This capability is essential in a complex environment which requires a swirling array of new and ever-changing formations whose structure is wholly contingent upon the optimal needs of a complex situation. This occurs today in uniquely capable Joint Task Forces (JTF) created for various deployments, none of which resembles a traditional organization. During missions, such as Operation Enduring Freedom (OEF) in Afghanistan, units within the organization are shuffled to meet the demands of the situation. This fluidity in structure is essential to create the optimal team of teams to win the battles at the operational level.

The rapid flow of information to all units within the structure is critical to maintain accurate situational awareness. Flow is a basic mechanism of complex systems, and units that can harness its advantages will excel. Flow between various nodes in the system must be capable along redundant channels to ensure uninterrupted exchange between all nodes. The higher headquarter nodes must constantly flow information downward; lower nodes must flow updated actions and information upwards. Most importantly, each node must constantly flow information laterally to all nodes within the organization. Modern technological innovations in communication and computing enhance this capability of information flow. This continuous flow of information is critical to situational awareness because in a complex system the action of a unit

causes unknown adaptive reactions elsewhere in the system. By rapidly flowing information, each node gains a holistic view of the system rather than a localized myopic view.

Interaction between the various elements of the system is the much more important than any physical element within the system. Therefore, a shift in thinking and planning is required to considered interactions and consequences of those actions upon the system rather than the specific actions within the plan. Interactions are the means by which non-linearity enter the system and make a complex system what it is. In a very simple example, the action by a soldier in pulling a trigger is inconsequential in itself. However the interaction of that action upon his weapon to shoot; the bullet to fly; the body of target; the mind of the shooter; the buddy of the victim; and so on reverberate throughout the system until that trigger pull causes the needless launch of nuclear weapons killing millions. At the operational level, planning actions which impact large portions of a system may have massive repercussion that are not expected unless the interactions are the focus of consideration throughout the process.

Chapter Three - Changes and Trends in Future Warfare

The fundamental nature of war has not changed, but the methods of waging land warfare have surely changed.³⁵ The participants, equipment, rules and strategy are so radically different now from ancient times that it is easy to mistakenly believe that the nature of war has fundamentally changed, but it has not. The survival instinct of a living creature demands adaptation to survive to changes in their environment. This chapter will explain the causes and implications of these changes.

A vision of the future of warfare has appeared over the past couple decades in a number of books, professional journals and presentations. One individual to first identify some of these potential changes was an Air Force Colonel by the name of John Boyd. However, the ideas espoused by Boyd did not focus on predicting the future of warfare as much as examining the trends throughout history in the conduct of warfare and how it has evolved. In a series of detailed briefings, Boyd led his audience along the progressive path of warfare and identified the essence of the various types of warfare - attrition, maneuver and moral conflict.³⁶ These innovative ideas were the foundations on which much of the current debate concerning future warfare is now centered.

Boyd's ideas were understood by many military officers and their implications were discussed throughout military circles until a vision of the future eventually began to emerge and appeared in an 1989 article titled "The Changing Face of War: Into the Fourth Generation" by William Lind and a group of military officers.³⁷ This controversial article sparked the growth of a small core group of military officers and civilian scholars interested in the changes occurring in the modern world and their implication on the future conduct and methods of warfare. Other

³⁵ Strachan: 8-34, 108-120.

³⁶ Boyd, John. "Patterns of Conflict" an unpublished presentation available online at <http://www.d-n-i.net/boyd/poc.pdf>

³⁷ Lind, William S., Keith Nightengale (USA), CPT John F. Schmitt (USMC), COL Joseph W. Sutton (USA), Lt Col Gary I. Wilson (USMCR), "The Changing Face of War: Into the Fourth Generation." *Military Review*. October, 1989: 2-11.

works including Martin Van Creveld's "Transformation of War" were published discussing the same possible evolution of future conflicts. Increasingly, military officers began to examine the Post Cold-War trends, and publish articles and papers discussing the possible implications these changes might have on the future conduct of land warfare. Many of these ideas began to receive the notice and support of senior military officers, particularly within the Marine Corps, which already enjoyed a reputation for exploring innovative approaches to warfare. All portrayed a future in which history more than ever served as a precursor of future events, except with a plentiful measures of modern technology added to the equation.

A summation of the global environment portrayed by the advocates of the theory of Fourth Generation Warfare (4GW) envisioned a world where the more historic concepts of warlords commanding their own little armies, despots brutally ruling their domains, groups of tribal-like warriors killing and destroying with impunity, and bands of thugs spreading chaos and disorder across entire regions would be much more common. Added to this environment would be a healthy portion of religious zealots and political extremists preaching their ideological rhetoric to the masses, a chaotic assortment of small terrorist cells, isolated bands of computer hackers, organized crime syndicates, and powerful drug cartels. It promises politically motivated shutdowns of key facilities on which we have come to depend, such as water distribution and hospitals.³⁸ It predicts the sabotaging and outright disruption of critical networks - power, transportation and communication. It warns of future employment of weapons of mass destruction by non-state actors or sub-national entities incurring massive casualties and destruction. Why? The continuing decline of the power and influence of nation-states since their birth in 1648 at the signing of the Treaty of Westphalia.³⁹

The first military service to acknowledge the possibility of these changes and adjust military doctrine to counter these new threats was the United States Marine Corps under the

³⁸ Van Creveld, Martin. *Transformation of War*: 205-212.

³⁹ Philpot, Daniel. "The Religious Roots of Modern International Relations." *World Politics*. Vol. 2, No. 52, January, 2000: 206-207, 245.

leadership of two of their insightful Commandants, General Alfred Gray and General Charles Krulak.⁴⁰ The basic premise of the argument was not a hard one to accept for a student of military history. The argument put forth by Boyd, stated that the historical progression of modern land warfare had focused first on the massing of manpower, then the massing of firepower, and third on the exploitation of maneuver. Lind and others argued that these represented three distinct generations of warfare. Furthermore, the advocates argued that the changes visible today point towards another generational shift - "the fourth generation of warfare."⁴¹

The importance of a generational shift into the 4GW lies in the implications this shift has upon the effectiveness of the current military land warfare doctrine against an enemy exploiting these changes. To consider these implications requires a more detailed understanding of the previous three generations. Much of the debate surrounding the 4GW addresses the possibility that the U.S. military is locked in a second generational mindset. For the purposes of this chapter, which is to identify differences in the conduct of warfare particular to fourth generation environment, that argument is immaterial and will not be addressed in detail

Fourth Generation Theory

First generation warfare was embodied in the close-order formations perfected by Napoleon, armed with cannons and massed infantry employed to stop the saber wielding charges of cavalry and massed infantry formations of his time. This generation of warfare and other following generations appear to have lasted approximately seventy years in duration until changes began to occur in the world. LTC Thomas Hammes correctly identified "the true drivers of generational change [as] political, social, and economic factors." He argued that successive generations require more than the simple passage of time or improvements in weapons, such as rifled artillery and machineguns to create a new generation. Rather, the birth of a new generation

⁴⁰ United States Marine Corps. MCDP 1-0 *Warfighting*. 1997.

⁴¹ Lind, William S., COL Keith Nightengale (USA), CPT John F. Schmitt (USMC), COL Joseph W. Sutton (USA), Lt Col Gary I. Wilson (USMCR). "The Changing Face of War: Into the Fourth Generation," *Military Review*, October, 1989: 2-11.

is more produced because of changes in the entire political, economic, and social structure of a society.⁴²

A historical example is visible in the birth of the second generation, which politically required a European political structure wed to a balance of power capable of withstanding the strains of attrition style warfare. Economically, it required an industrial base capable of producing and transporting the vast quantities of weapons and ammunition required in the new generation of warfare. Finally, the social fabric and institutions of Europe needed to support the systems required to sustain the atrocious losses associated with second-generation attrition style warfare.⁴³ Without the fulfillment of these critical requirements, the birth of a new generation cannot and will not occur. Therefore, the second-generation battlefields were dominated by armies capable of managing the massive firepower available from the factories of the Industrial Revolution. The massive firepower of this new generation could not be overcome in doctrine created from the genius of Napoleon's dominance during the first generation of warfare. The armies of Europe were forced to choose between changing their doctrine concerning the conduct of warfare to accommodate the unstoppable changes occurring in the world or become irrelevant in the future. The quickest learners and subsequent masters of this newer form of warfare became the Prussian war machine of the Franco-Prussian Wars and into the initial years of the First World War.⁴⁴ In the second-generation battlefield, success fell on the side with the most and best firepower. However most, if not all, the fundamental principles identified by Clausewitz in "On War" in his study of Napoleon remained the same, but now demanded a different application to meet the changes inherent in the second generation.

Finally, the third generation of warfare concentrated on the exhaustion caused by multiple and decentralized attacks into the enemy's rear and flanks in an effort to agitate and

⁴² Hammes, Thomas X. "The Evolution of War: The Fourth Generation" *Marine Corps Gazette*. Vol 78, No.9, Sept, 1994: 35-44.

⁴³ Ibid

⁴⁴ Strachan: 90-105.

disrupt his formations. The essence of third generation maneuver warfare is to shatter battlefield linearity by seeking weak points or gaps in enemy thinking and dispositions, then taking advantage of these openings before the enemy can rectify them. In essence, exploitation through space and time. An example of the gradual growth of this concept and the increasing ineffectiveness of attrition warfare is evident in the grinding down of German offensives in 1918 from sheer exhaustion against an enemy applying minor changes inherent in the newer generation. The implications of the birth of this new generation of maneuver warfare, was immediately understood, studied and refined during the interwar period by the German Army, particularly Guderian and others. The evidence in history again shows the ramifications of astute army leaders anticipating, learning and adapting to new generational changes, compared to an opponent unable or unwilling to acknowledge the changes occurring around them. The initial success resulting from the conceptual shift to the third-generation maneuver concepts of the early "Blitzkrieg" operations of World War Two, seems proof enough of the importance of identifying, learning and adapting to possible generational changes.⁴⁵ The ultimate refinement and application of this maneuver concept arguably would be the U.S. military's Air-Land Battle Doctrine⁴⁶, though some critics still argue that it partially misses the mark of true maneuver warfare.⁴⁷

All three of the previous generations had the same strategic and operational concept in mind – defeat of the enemy through military means alone. The fourth generation, instead is based on a vastly different operational concept because it is a highly irregular and asymmetric style of warfare that focuses on the deliberate bypass of the opposing, superior military force in favor of a direct attack on cultural, political, or economic targets.

⁴⁵ Corum: 25-34, 122-143.

⁴⁶ FM 101-5

⁴⁷ Lind, William, John F. Schmitt, and Gary I. Wilson, "Fourth Generation Warfare: Another Look" *Marine Corps Gazette*. December, 1994: 32-37. Also recommend reading Lind's book *Maneuver Warfare Handbook*. Boulder, CO: Westview Press, 1985.

"Roughly speaking, fourth-generation warfare includes all forms of conflict where the other guy refuses to stand up and fight fair...the distinction between war and peace [is] blurred to the vanishing point... No longer are there definable battlefields or fronts. Indeed, the distinction between civilian and military ceases to exist."⁴⁸

Many, if not all forms of warfare can be viewed as asymmetric, especially maneuver warfare, since it attempts to create and exploit enemy weaknesses, rather than directly engaging or trying to reduce military formations and fortified positions. Vincent J. Goulding claims that asymmetric warfare is as old as warfare itself.⁴⁹ However, despite the highly asymmetric characteristics of fourth generation warfare, is not the same as "Asymmetric warfare." An easy way to understand "asymmetric" in fourth generation warfare is to think of it as warfare that has left the traditional battlefield. The conventional military application of asymmetry focuses on the exploitation of weakness in the enemy military structure. The difference with the "asymmetry" of fourth generation warfare is that it ignores all of the sources of power contained within the DIME, instead striking at the heart of the social fabric of a nation.

Societal Trends Shaping a Generational Shift

Thomas X. Hammes identified that the emergence of a new generation must be predicated by significant societal changes warranting and enabling such a dramatic shift in the conduct of warfare. To substantiate that such a shift is possible requires identification of potential societal changes meriting the birth of this new "fourth generation." To identify these significant societal changes requires a study of current political, economic and social trends in the world today.⁵⁰ Examples of prevalent trends include the splintering of nation-states into smaller independent republics; the availability of relatively inexpensive small arms and weapon systems; the increasing strength of ideological based groups; the emergence of the United States as the sole

⁴⁸ Richards, Chester. *Swift and Elusive Sword*. Washington DC: National Defense University Press, 1999: 39-40.

⁴⁹ Goulding, Vincent J. Col, USMC. "Back to the Future with Asymmetric Warfare." *Parameters*. Winter, 2000 – 2001: 21-30.

⁵⁰ Fuller, Fred. "New Order Threat Analysis: A Literature Survey." *Marine Corps Gazette*, April, 1997: 46-49.

superpower; the increasing scarcity of resources; the exponential growth of global connectivity and the influence of global media.⁵¹

The continued relative decline in the monopolistic power and prominence of the nation-state as an entity, together with the growth in numbers of sub-state entities including large criminal organizations, warrior groups, tribal bands, terrorist networks, leads towards increased fragmentation of existing nation-states. This regional political, economic and social upheaval results in genocide, famine and pestilence.⁵² The long-term effect is exponential growth in starving or diseased refugees across the globe. Note the conflicts over the last decade in Burundi, Chechnya, Liberia, the Philippines, Lebanon, Iraq, Ethiopia, the former Yugoslavia, Rwanda, Somalia and Angola. The post Cold-War world has created an increasing willingness by ideologically driven sub-state groups to attack because many of the controls imposed on these groups disappeared after the Cold War. The fragmentation of nations and the political, ethnic or religious factionalism of such groups, especially in regions such as the Balkan region make tensions more likely to result in violence.⁵³

The economic conditions of places in the world such as Russia, China, and many third world countries make the sale of the weapons too lucrative for the black marketeers around the globe to stop.⁵⁴ Arms merchants willing to sell a multitude of tactical weapons ranging from assault rifles and anti-tank weapons to man-portable surface-to-air missiles and high explosives. Despite recent successful efforts to freeze the assets of terrorist organizations, an increasing trend by non-state actors to acquire assets through kidnapping, extortion and drug trafficking indicates an important change. With this increased access to large amounts of money, sophisticated weapons have found themselves in the hands of a diverse array of non-state actors.

⁵¹ Snow, Donald M. *UnCivil Wars: International Security and the New Internal Conflicts*. Boulder, CO: Lynne Rienner Publishers, 1996: 50-58.

⁵² Snow, Donald M. *UnCivil Wars: International Security and the New Internal Conflicts*. Boulder, CO: Lynne Rienner Publishers, 1996: 11-23.

⁵³ Huntington, Samuel P. "The Clash of Civilizations?" *Foreign Affairs*. Summer, 1993: 22-49.

⁵⁴ Kaplan, Robert D. *The Coming Anarchy*. New York: Random House, 2000.

Strategic and heavy conventional arsenals relied upon for so long during the years of the Cold War now provide little or no deterrent to entities that have no fear of them. They are essentially impotent since they cannot be brought to bear successfully on targets difficult to accurately identify, unlikely to be separated from a surrounding mass of innocents or willingly ready to die as martyrs. Precision munitions have proven to be very effective when the conditions have been perfect, but a bullet through the head can be just as effective as a precision-guided munition. In fact, a bullet fired by a sniper is probably the most accurate precision-guided munition available. The real difference is the cost, training and risks involved.⁵⁵

Most potential enemies of the United States acknowledge that success against the U.S. military in a conventional, non-nuclear conflict is very unlikely. The result is a lack of a viable, traditional military option to oppose the monolith of the U.S. military.⁵⁶ This trend of a growing disparity between the military capability of technologically advanced nation-states versus undeveloped nation states and sub-states is manifested in the growth of asymmetric attacks against American forces and the nation.

The urbanization of the global population throughout the world is resulting in extreme concentrations of massed humanity into small geographic areas. This concentration has produced a frightening pace in the scarcity of resource particularly, water and arable land. The local governments are increasingly unable to cope with the demands of their citizens, and in concentrated areas have even placed unmanageable strains on the governments of nation-states.⁵⁷ An increasing number of natural disasters usually a direct result of drastic measures to accommodate the short term needs of the masses, has resulted in the long-term devastation from flooding or famines due to poor resource management. Efforts to provide assistance usually tend

⁵⁵ Davis, Jacquelyn K. and Michael J. Sweeney. *Strategic Paradigms 2025: U.S. Security Planning for a New Era*. Brassey's, VA: The Institute for Foreign Policy Analysis, Inc., 1999: 175-204.

⁵⁶ Horowitz, Donald L. "A Harvest of Hostility: Ethnic Conflict and Self-Determination after the Cold War" *Defense Intelligence Journal*. 1991: 1-27.

⁵⁷ Sen, Yima. "Managing Water for African Cities." *UN Chronicle*. Vol. 38, No.1, March-May 2001: 56-57.

toward endemic corruption and devastated economies. The result is local or regional violence, which continues to spread like a cancer to adjacent areas vulnerable to the threat. A second order effect is the crippling vulnerability to attacks upon infrastructures that the masses rely upon for survival. This growing propensity throughout the world of concentrated targets perfectly designed for weapons of mass effect provides a perfect means to strike a devastating blow to the United States, even if delivered by unsophisticated methods.

The exposure of uneducated masses to orchestrated information warfare through a vast array of mediums, particularly the internet provides cheap and relatively invisible means of influencing. The Ayatollah Khomeini utilized the relatively simple information medium of a tape-recorded message played on simple handheld players to disseminate his views and influence the masses during the Iranian Revolution. Information technology has increased the pace of this trend to communicate and manipulate massive audiences concerning a particular view aptly referred to, as the "CNN effect". The world can view battlefield images with relatively real-time rapidity rivaling, and many times surpassing, the collection efforts of the intelligence community. The political ramifications of this trend affect decision making across the globe when searing images of casualties are broadcast throughout the living rooms of the world.

An understanding of the potential threats that exist is crucial to understanding the future paradigm of warfare. If the nature of warfare has not fundamentally changed and the efforts of any military remains to attack the enemy asymmetrically, that is to strike where is he most vulnerable, then a new approach to understanding the enemy is necessary to achieve this asymmetric advantage against threats that are atypical of traditional warfare. In fact, Martin Van Creveld suggests that the modern military officer begin his study of military history in the Middle Ages when war was much less organized and the rules of the traditional battlefield did not exist, and maybe even focus more attention on gang or tribal warfare.⁵⁸

⁵⁸ Van Creveld: 149-156.

Most if not all of the traditional threats from previous generations are still present. In many cases instead of vanishing, they simply mutated into newer hybrid threats. While at the same time, new threats have appeared or in some cases reappeared. The threat spectrum now includes enemies capable of strategic nuclear warfare, nation states threatening large conventional struggles fought on traditional battlefields in accordance with the well-understood rules of the Geneva Conventions, sub-state actors willing to fight a small-scale military conflict, non-state actors fighting a guerilla war, and radical extreme organizations daring to strike unconventionally. Individually each of the latter may not be a great threat, as a whole if ignored can be devastatingly destabilizing especially when others see one faction successfully exploiting a perceived weakness.

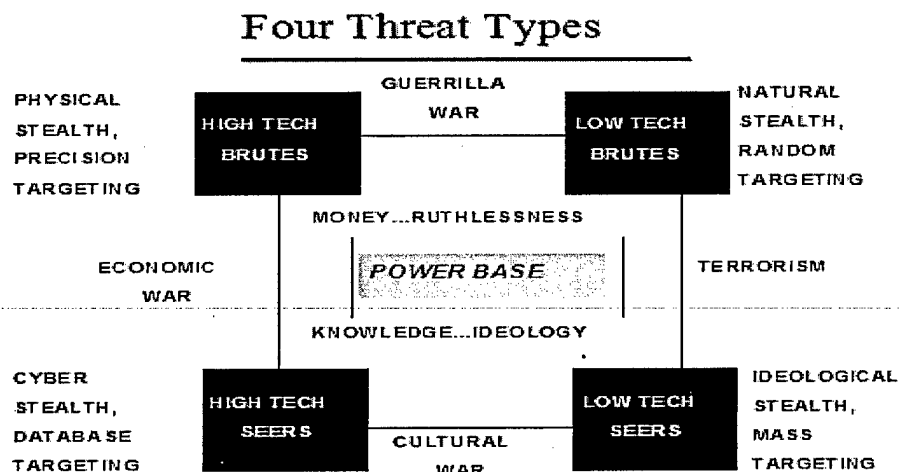


Figure 3 – Four Threat Types

To simplify the array of potential new and old threats, Dr. Robert Steele has categorized them into four distinct groups based on their power base, purpose and capabilities.⁵⁹ The first threat encompasses the more conventional traditional threats of the past in which states possess conventional forces and nuclear capabilities. Their power base emanates from their economic wealth. The money available to the “High-tech brutes” allows the application of high levels of

⁵⁹ Steele, Robert D. “The New Craft of Intelligenece: Achieving Asymmetric Advantage in the Face of Nontraditional Threats.” *Studies in Asymmetry*. Carlisle, PA: Strategic Studies Institute, Feb, 2002: 12.

technology to acquire precision targeting and large modern conventional forces. Due to the size and complexity of these massive forces they are also easier to monitor and have great difficulty achieving strategic surprise, therefore, must mainly rely on physical stealth. They are typified in the traditional enemies of the Cold War and dominant in second and third generation warfare. The High-tech brute category is the home of the traditional nation-states that is reluctant to fight, but does so very violently. This threat category historically represents a small percentage of conflicts, but represents a high magnitude of risk. They are the enemy threatening the high and mid-intensity conflicts of the future. Typical examples, of this threat currently include Iraq, China, Russia, Iran, North Korea, and any other nation state opposed to the interests of the United States.⁶⁰ An important interaction to note is that high-tech brutes often resource the revolutionary wars in a region or within the borders of their enemy. Another key threat interaction is the employment of "high-tech seers" by many "high-tech brutes" to disrupt the domestic financial, transportation and communication infrastructures of opposing nation-states.⁶¹

The next category is the "Low-tech brutes" typified in the transnational organizations such as criminal syndicates and terrorist groups that do not possess high technology capabilities, but are capable of extreme violence in concentrated areas for limited periods. Their power base firmly lies in their unparalleled ruthlessness. They are very difficult to locate and typically loosely organized, but seldom unified beyond the clan or group level. Because of this, they are normally, unable to organize beyond the level of a "Revolutionary army" or "Warlord army." Their ruthlessness stems from the composition of the group by criminals or violent radicals that aggregate into arbitrary organizations for individualized reasons to achieve random goals by whatever means are necessary. The Special Operations Command (SOCOM), historically, was the counter to this threat. Most conflicts arising from this category would be classified as low intensity, but increasingly make up the majority of conflict threat profiles. The natural stealth and

⁶⁰ Steele: 9-11.

⁶¹ Walters, Eric. "An Introduction to Maneuver Warfare." American Military University, 2002 slide presentation available online www.d-n-i.net/fcs/ppt/walters_future_warfare.ppt

ambiguity of this threat category makes the preferred accurate targeting of members of this group by standoff, high tech precision munitions, very difficult without enormous expenditures in human intelligence assets. Additionally, the proliferation of this category and randomness of purpose causes tracking locations and countering of action extremely difficult except through rapid and decisive action or prolonged engagement.⁶² The interaction of this group with "high-tech brutes" results in a growing profusion of transnational guerilla armies associated with drug-trafficking cartels, local warlords and international crime syndicates.

The third category is the "Low-Tech Seers" whose power base is found solidly in their ideology. Members of this threat category are born from and live among the large groups of humanity, numbering in the millions, that daily attempt to survive despite the largely unresolved and legitimate needs of food, water and freedom. The majority of the group is reluctant non-violent actors, forced through circumstances or cultural differences to confrontation out of desperation or resentment. Excellent examples of this growing threat reside in the circumstances of surrounding the recent situations in South African, Rwanda, Somalia and many others. From this volatile mixture is born the typical "Angry Young Man" of many terrorist and criminal organizations. Individually, each does not represent an insurmountable threat, but collectively the masses of this category cannot be dismissed. The blinding hatred of these "have nots" is fueled by an internal resentment of the "haves" who they believe have misused and cheated them of their rightful freedoms and place in the world. The importance of the interaction of this category with the new environment is that the small minority of individuals capable of dangerous action are members of a mainly non-violent group numbering in the millions. This fact makes them impossible to identify because their beliefs are hidden within their hearts and minds, and are not exposed until they act upon them in violent actions. Additionally, because they are fueled by a strong belief in their cause and feel they have nothing to lose, but much to gain by dying for their cause. Their greatest potential threat is in the acquisition of weapons of mass effect. An example

⁶² Steele: 13.

of the potential threat from within this category is represented by the proliferation of groups announcing the need for, and the ever-growing response to the calls for a "Jihad." An important interaction visible in the modern world is the crossover by "low-tech seers" to utilize the ruthlessness of "low-tech brutes" to do heinous acts of terrorism.⁶³

The last group is the newest and most capricious mixture of individuals capable of conducting what is termed cyber-war or information attacks across the new global environment. They are the "High-Tech Seers" powered by knowledge and technology. Many times, they are sponsored by rogue states, but often operate individually or in gang-like organizations spreading random chaos. This group conducts economic espionage disrupting trade and economic operations in the global economy, and more significantly, information vandalism by a multitude of computer viruses. This threat within this category is largely subtle and misunderstood until acted upon with devastating consequences in the new societal environment of the information age. The interaction of high and low-tech seers sharing common ideas can easily foment cultural wars among the cultural elites and through them the masses.

A look at the interaction of the new generation of warfare with the environment identifies an important change. The implication of the change in threat patterns caused by this interaction is important because the traditional view of threats can be partially traced to the conflict continuum that as the level of intensity of conflict increases the likelihood of it happening decreases. The implications of change in 4GW indicates that as the new spectrum of threats increase so will the frequency of conflicts to the point that the risk begins to also increase.

Figure 4 below represents the idea that the true value of perceived threats is the product of factoring the seriousness of a threat (risk) with the likely frequency of it occurring in the future. At the top left, the major regional conflicts (MRC) are accurately depicted as rarely occurring, but the risk of defeat means devastation to a nation-state. The increasingly more

⁶³ Steele, Robert D. *Studies in Asymmetry*. Carlisle Barracks, PA: Strategic Studies Institute, 2002.

common, small-scale conflict (SSC) is depicted as more frequent, but less risky to the nation's vital interest.

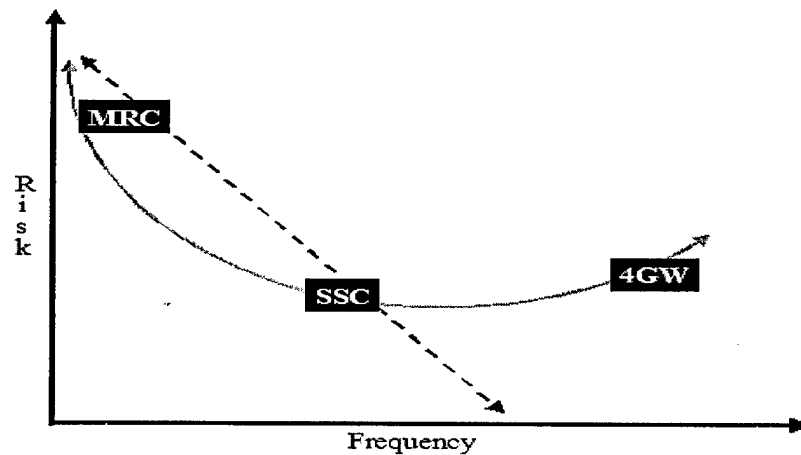


Figure 4 - Conflict Continuum

The dotted line displays the popular linear approach, while the solid line represents the more realistic, non-linear view of the continuum. The important change is displayed in the non-linear view, by the unprecedented growth in frequency of 4GW conflicts never before seen in previous generations. The increase in risk is created by effect of non-linearity from the interaction of the many conflicts, which creates a risk much greater than the simple sum of the individual conflicts. We know this is truth from the study of chaos and complexity.

Chapter Four - Optimal 4GW Capabilities

The actions and thinking of the past simply will not suffice in a future where the information revolution, technological advancements and rapid complex changes are sure to dominate.⁶⁴ The U.S. military is capable of unrivaled reach across the globe and in many circumstances can destroy opposition with limited risk. However, the current price is a slow reaction time and focuses resources toward the conventional battlefield, yet ignores the trends of troublesome small-scale conflicts that will involve the military in the future.⁶⁵

Given the facts concerning recent trends occurring across the globe, combined with the assumption that the threat base is expanding to include hybrid versions of newer threats it is clear that a new generation of warfare has arrived. The name of this change is irrelevant, whether labeled a “generational” change, an “epochal” change or a “paradigm.” The important consideration is the identification, definitive description and implication of these changes. The intent of this chapter is to identify capabilities that produce a desired effect, rather than focusing on capabilities most appropriate for a predicted threat. By doing so, the military will mold the future environment proactively with the responsive use of anticipatory, graduated but unstoppable force; rather than attempt to predict, then respond sluggishly in a reactive manner with massive military force.

The answer is not straightforward and a distillation must occur bringing the best and relevant capabilities to the forefront. Warfare was complex in the time of Clausewitz and it remains complex no matter the battlefield, and if anything, future battles are going to be much more complex than before. The inevitability of complexity will not change, but our understanding of complexity is growing. We must continue to expand this understanding and leverage these strengths in the future conduct of war.

⁶⁴ Hall, Wayne. “Thinking and Planning: Vision 2010.” *Land Power Essay Series*. No. 98-6, Institute of Land Warfare, Sept, 1998: 2.

⁶⁵ Ibid

Initiative and innovativeness is needed at all levels to succeed in future battlefields. Initiative in the changing environment of the future will enable a leader to focus energy in pioneering new courses of action through self-reliance and without prompting. Innovation is necessary because it allows great leaps of thought that deviate from established doctrine, practice or form resulting in novelties that transcends the mundane products of typical systematic, evolutionary thinking. The vagaries of the diverse spectrum of threats in the new generation, demands the abandonment of dogmatic application of set doctrinal answers to questions rarely before encountered. Initiative and innovativeness are inherently undisciplined, contrarian and iconoclastic in nature. To nurture this capability requires several key ingredients - Diversity, Risk Tolerance and Open-mindedness.⁶⁶ In essence, we want leaders and soldiers willing and able on their own to try new approaches to old and new problems.

Leadership needs to possess depth and breadth in training and education. The lens through which a leader views the world and decides his actions, are tinted by his experiences.

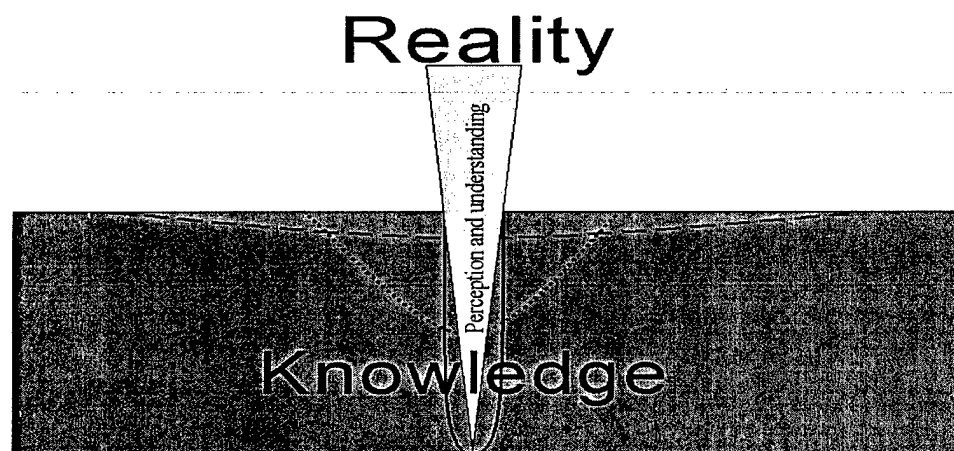


Figure 5 - Depth and Breadth of Knowledge

Depth and breadth create a focused perspective with broad knowledge. A singular focus on leader training on the tactical application creates great depth, but is viewed from a narrow perspective. By contrast, a broad, yet shallow education does not provide the necessary expertise

⁶⁶ Negroponte, Nicholas. "Creating a Culture of Ideas." *Technology Review*. Feb, 2003: 34-35.

to understand and apply the operational art, because it lacks solid practical knowledge necessary to correctly interpret the situation. What is desired is mixture of education and training to provide maximum perspective with depth of understanding in difficult situations. A holistic education and realistic training situations, prepares the mind to operate in confusing environments. This emphasis is on properly understanding what is observed as much as the ability to actually see it.

Agility and quickness, was identified by Col. John Boyd, as a hallmark for success in a future warrior.⁶⁷ Agility in individuals as well as organizations allows the ability to change and adapt to situations. Agility in a military force is absolute in an environment where planning assumptions will likely be incorrect and the plan must quickly alter to reflect reality as an emergent plan.⁶⁸ Without agility, a leader rigidly dependent upon a plan subsequently invalidated through the identification of false assumptions would be forced to continue to rely on this same invalidated plan and “fight the plan rather than the enemy.” Physical agility allows the ability to modify a force package fluidly and rapidly enroute to an area of operation. For example, if a situation drastically changes during execution relative to the original plan and the forces necessary for success are vastly different from those based on planning assumptions, then the ability to agilely change follow-on forces in time and space is a great benefit.⁶⁹ Quickness provides complimentary strength to agility because it provides speed to fluidly transition between actions.

The capability of operating at the levels of tactics, operations and strategy at the same time and space is essential. It requires a deeper understanding of the relative interrelationships of various actors at each level. This is represented in an adaptation of the continual re-orientation and feedback of Boyd’s OODA loop.⁷⁰ The ongoing cross-reference of data from multiple sources and perspectives to properly orient to the reality of the situation is only possible if the

⁶⁷ Ibid

⁶⁸ Mintzberg: 24-27.

⁶⁹ Wass de Czege, Huba BG, *Conceptual Foundations of a Transformed U.S. Army*, Land Warfare Papers, No. 40, Institute of Land Warfare, AUSA, March, 2002: 9-16.

⁷⁰ Boyd, “Essence of Winning and Losing” unpublished presentation dated 1996, slide 4.

commander is able to continually re-orient a conceptual frame of reference at all level - tactical, operational, and strategic levels. Shimon Naveh's similar conceptual framework is illustrated this way by overlaying the concurrent OODA loops that a commander continually operates within.⁷¹

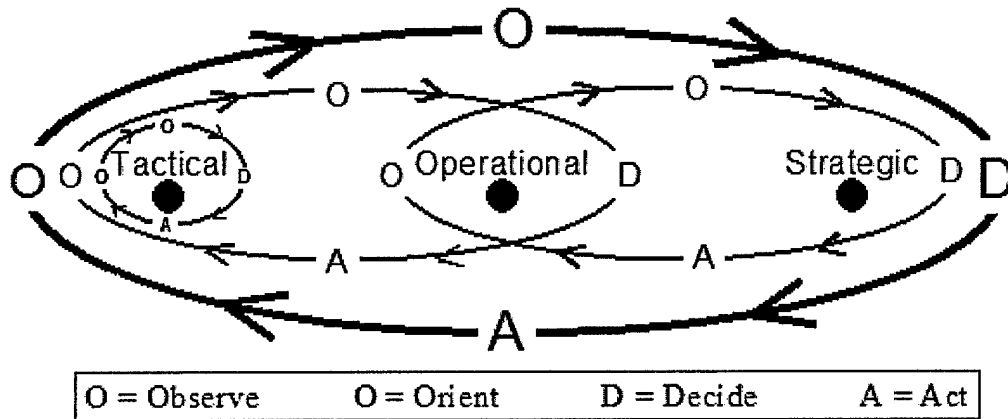


Figure 6 - Concurrent OODA loops

A tactical commander of the past has concentrated on his local tactical OODA loop, unconcerned with the bigger operational and strategic OODA loops. An operational commander functions as the bridge between tactics and strategy, but is physically incapable of observing the situation at both levels. Yet, operational commanders need to orient and make operational decisions executable between the two poles of tactics and operations, but have significant effects at multiple levels especially in modern warfare. In future warfare, the actions of a tactical commander create much greater effects on the orientation at both the operational and strategic level. The future tactical and operational leaders must now be capable of leveraging the concept concurrent loops. This emphasis on concurrent loops creates a requirement for the availability of strategic assets, especially real-time intelligence at the lower tactical levels.⁷²

The future military must be capable of going beyond the current requirement of comfortably operating in the joint environment of Army, Navy, Air Force and Marine components. The fluidity of operations across the full spectrum of military functions inherent in

⁷¹ Naveh, Shimon: 258-259.

⁷² Wass de Czege, Huba, BG (R), *Toward a Future Army*: 50-51

4GW requires habitual joint operations except at the lowest tactical levels. The global nature of the threat spectrum also ensures that future conflicts will invariably require military units at all levels to function comfortably in coalition organizations consisting of nations with disparate languages and capabilities. An interagency task force rather than the joint force must become the norm for future operations. The loss of the monopoly on violent conflict for the military requires that the military operate as an equal member of a team of various agencies including State, Commerce, Justice, CIA, Treasury and even Health and Human Resources. To be most effective the military formations of future land warfare must incorporate into the traditional military structure components that are non-military in structure and culture, yet provide vital operational capability in non-military tasks for which military forces are ill equipped and less effective in executing. This capability and cooperative skill has previously rarely been asked of by combat formations, but in the ambiguous environment of tomorrow, this skill will provide a commander leverage with asset equal in importance to ultimate success as the traditional weapons of war.

The capability of global operational reach is paramount to success in future of military conflicts. The threat spectrum of future war indicates that the military can no longer expect the luxury of operating from an established theater infrastructure or afford the wait required to develop such infrastructure before operations begin.⁷³ Instead, the capability must exist for joint, coalition, or interagency operations to be conducted directly from limited predetermined locations mainly from within the territories of the United States or allied territory. The permanent infrastructures across the globe of the past are quickly becoming much more vulnerable to attack. The capability of extended operational reach enables the rapid projection of force packages capable of immediately fighting small-scale battles, while equally capable of sustainment by other globally projected forces. This capability implies the ability to maintain the tempo of deployment and operations to increase the size of operational forces to fight longer and bigger campaigns. The achievement of this overwhelming operational tempo will allow the military to

⁷³ Wass de Czege, Huba BG (R), *Toward a Future Army*: 6, 29-32.

seize the initiative and continue to dominate without pause until conclusion. This capability is achievable only through the complimentary utilization of air and sea resources.

Cultural awareness provides a valuable capability that is intangible, yet significantly influential during the likely cultural clashes of 4GW. It requires a collective recognition by the military of the importance of the cultural differences existing within the global environment and how these differences can be exploited to our benefit, or unwittingly magnified to our detriment. Without an appreciation of the diversity of cultures in global operations, then the likelihood of inadvertently creating resentment and resistance is much greater. Some of the difficulties in United States involvement during the Vietnam War can be traced to a lack of cultural literacy, which was exploited to our detriment by the North Vietnamese leadership.⁷⁴ In 4GW the likelihood increases of opposing an enemy dominated by diverse cultures. An understanding of the impact of actions within that culture is paramount. In many cultures, particularly the Islamic culture from which will emerge likely opponents of the fourth generation the need to "save face" or be defeated with honor is paramount to an individual, and can be exploited to our benefit. The opponents in this new generation are less likely to be the professional soldiers of the previous generations. More likely they can be looked at from a perspective of "fighters" whose actions relate closely to the tribal belief that every member of a village is a potential fighter. In Chechnya, the Russians referred to the Chechens as fighters not soldiers, because they fought with unbridled vengeance and did not follow the rules.⁷⁵ Understanding cultural differences will identify our exploitable vulnerabilities, and expose the opponent's vulnerabilities. This is an important aspect to consider especially with the growing implications associated with the "CNN effect" when inappropriate cultural actions are exploited by an adversary. In the future, perception will become just as important as reality.

⁷⁴ Race: 210-266,271-276.

⁷⁵ Goulding: 10-31.

Chapter Five - Recommendations

The first step to enhancing the future military is the identification and acceptance of a unifying American theory of war from which Joint and Service doctrine can be derived. This must be done at the highest levels of the military in conjunction with contemporary military theorists throughout the nation, under the authoritative guidance of the Joint Chiefs. This will enhance the desired harmony of Joint and Service operations and the overall conduct of war in the future generation. It must include an honest assessment of the understanding of the nature of war, which may now encompass aspect previously not seen, but has always been present.⁷⁶

The first priority in the future military is education as a key component in the development of leaders and soldiers. This is achievable through slight modification in the contemporary understanding of the priorities of effort in the current development of optimal military forces. The traditional process for the development and formulation of force structure utilized the process of the simple linear function of the factors of DTLOMS (Doctrine, Training, Leaders, Organization, Materiel and Soldiers). Instead, a more appropriate non-linear view would properly weight each factor and include some missing aspects necessary for success in the future. Leader development in the form of education and experience is paramount to success for optimal future forces. Soldier and leader development is highlighted in the modified version by indicating that despite development in doctrine, organizations, or materiel the product of the process is a factor of the value of the soldiers and leaders. Most importantly, leader development is emphasized because the absence of any of the three key factors of training, education or experience result is an immediate diminishment of capability in the force design and structure. Therefore, it is imperative that the development of the leader is begun at the initial entry point and continued throughout his career. The focus must be in all realms - physical, mental and moral. Mental skills will be continually strengthened, trained and honed to full potential through rigorous mental exercise as opposed to the current exclusive emphasis on physical skills.

⁷⁶ Dubik: 1

Training will address much of the physical requirements, a holistic education will strengthen the mental capabilities and challenging experiences will bolster the moral aspect of an individual. By

$$(D+O+M) \times (S+L)^{T \times E \times E}$$

D = Doctrine

L = Leaders

O = Organization

T = Training

M = Materiel

E = Education

S = Soldiers

E = Experience

Figure 7 - Improved DOTLMS model

doing so we will have addressed the importance of the need for a broad education and a much more holistic understanding of the world. To amplify this strength a linkage must be created within the promotion system to the importance of education in the future potential of a leader.

Individuals not displaying the potential to grasp difficult and complex situations should not be promoted through the system, just as physical capabilities and attributes are currently used to measure the potential of a leader.

Second in priority is the development of a force structure for all land warfare components that is similar in concept to the force packaging utilized by the Marine Corps in the creation, establishment and training of an expeditionary MAGTF. The concept behind the creation of a MEF is to create a cohesive force trained, equipped and packaged to possess certain critical capabilities not inherent in any of the parent organizations. The additional strength of this structure is the synergizing effect of a multi-functional ground component, air component and logistic component that together can operate semi-autonomously. It addresses the joint aspect desired in most deployment, but packaged into one cohesive unit of action capable of executing

operational missions. The expeditionary nature of a MAGTF need not be a limiting factor to this structure because the army can create "crisis response" forces with expeditionary quality, alongside robust follow-on "strategic response" forces to fight longer campaigns.⁷⁷ These force packages will be created from within the tactical training structure of standard infantry divisions from which a force package is detached to form a capabilities based force. The division trains, equips and prepares the organic battalions and brigade size forces in the tactical expertise expected for those types of forces, but is not the organization in which those forces normally fight. Task forces need to be organized at the brigade level as Joint Combat Teams (JCT) similar to a Marine Expeditionary Brigades (MEB). These capability-based brigade size combat teams can be joined to form a larger division level Joint Task Force (JTF) and corps sized Joint Task Groups (JTG) that train, deploy and fight as one cohesive unit.

The enhancement of the capability for multiple means of deployment and employment, along with specific specialization in relation to terrain, climate, forced-entry and sustainment is critical. Specialization enables land warfare formations to focus on a specific capability to provide critical expertise in certain areas such as urban fighting yet, provide an operational commander the freedom to deploy by a variety of means. The deployment and operational employment of these forces should not be restrained by the means of entry, the terrain, or climatic factors. This implies the creation of formations that have specific characteristics unique to each organization which prepares them to excel in a situation best suited to their composition, but also capable of operating in other environments or situations. Creating military forces, capable of deployment by multiple means of delivery will significantly expand an operational, and strategic commanders options. The ability of operational maneuver by these forces within the theater then maximizes the operational commander's ability to adapt to the realities of the battlefield. This is attainable for most, if not all units, in regards to airborne, heliborne, and amphibious deployment

⁷⁷ Wass de Czege: 28-30.

modifications with current technological advancements as noted and illustrated by BG David L. Grange and others in Air-Mech Strike.⁷⁸

A lower priority recommendation is the need for all soldiers and leaders at certain levels to become proficient in a secondary language and culturally educated in a particular area similar to the current requirements for Foreign Area Officers (FAO). A mandatory requirement for promotion to certain levels such as a field grade for officers and the grade of E-6 for non-commissioned officers would ensure this capability is maintained at all levels throughout the military forces. This provides a valuable capability within the military of language proficiency during deployments to non-English speaking areas around the globe. It would allow soldiers in hostile areas to more efficiently gather intelligence, communicate with local non-combatants and understand cultural differences in an area of operation. It also reduces the cumbersome burden of integrating reliable and trustworthy translators in combat units. It enhances the ability to integrate non-English speaking coalition forces during both planning and execution. This capability is attainable through a significant expansion of the Defense Language Institute (DLI) to include the expansion of available languages to cover the entire spectrum. This capability directly addresses the critical future need for cultural awareness, approaching a problem from multiple perspectives, holistic education, and breadth and depth in leader development.

A further recommendation is the establishment of inter-agency organizations into tactical force structures during all deployments. This interagency task force needs to be based around the combat teams and supplemented by appropriate lethal and non-lethal fires. The robustness of this organization must alter based on mission profile requirements. For example, SASO would include a larger force structure of this type, while the package for small-scale conflicts would likely be smaller. This organization would effectively provide humanitarian assistance and non-combat related missions that occur within any combat theater. The likely force structure would

⁷⁸ Grange, BG (R) David L., BG (R) Huba Wass de Czege (R), LTC Rich Liebert, MAJ Chuck Jarrot, MAJ Al Huber, LT Mike Sparks. *Air-Mech-Strike: Asymmetric Maneuver Warfare for the 21st Century*. Paducah, KY: Turner Publishing Company, 2000.

include significant numbers of experts in Civil Military Operations (CMO) that are normally resident only in limited Civil Affairs (CA) battalions. An important inclusion to this force would be liaison officers (LNO) from the various private and governmental organizations and agencies that focus on humanitarian assistance. They would provide a valuable liaison capability that would enhance synchronization and efficiency of non-combat operations while simultaneously providing the proper expertise to leverage the available resources quickly and effectively. More importantly, the structure would need to include expert representation from the various governmental agencies not represented within the typical military structure to include the Central Intelligence Agency (CIA); Federal Bureau of Investigation (FBI); State Department and the United Nations (UN).

The final recommendation is the creation of experimental combat training areas similar in structure to the current Combat Training Centers (CTC), but with a focus on the training of innovation and initiative in difficult situations would allow enhance development of many identified critical capabilities. Training centers would allow experimentation in new methods of conducting warfare at the tactical and operational levels. By emphasizing the positive aspects of unsuccessful plans rather than the need to succeed will allow the development of potentially better methods while also developing the understanding of why the doctrinally correct solution may be the best. While these experimental laboratories allow innovativeness, the traditional CTCs remain to continue to fulfill the role of training and evaluation of the readiness of combat forces in the established doctrinal methods.

Conclusions

The validity of these recommendations is derived from the examination of land warfare within the conceptual framework of complex adaptive system (CAS) theory and fourth generation war (4GW) theory. This provides a unique perspective and valuable insight into the optimal capabilities and characteristics for the future military force because the traditional views on military conflict have begun to change. Doctrinal publications are turning away from the linear

Newtonian view because warfare is better described as a clash between complex adaptive systems. The new science of CAS as described by Professor John H. Holland better describes warfare in biological rather than mechanistic terms using science metaphors. Dr. Andrew Ilachinski provides the relevance of complex adaptive systems to land warfare in his work to model land combat as a complex adaptive system. A distillation of their work identifies the optimal capabilities and characteristics for operating within the complex adaptive system of the modern battlefield.

The methods of waging warfare are also changing on these modern complex battlefields. The fundamental nature of warfare has not changed, but changes in the methods and conduct of warfare appear to be shifting. The emergence of a new form of warfare and the changing trends of the modern world create significant implications on the future conduct of war. Whereas the emphasis in the past has always been towards large, identifiable foes with professional standing armies the future may require a reorientation of the military towards new kinds of threats, including our opponents in the war on terrorism. Optimal capabilities and characteristics for a military faced with this task require new methods of waging war.

Complex adaptive systems theory provides solutions for improved success in modern land combat and fundamentally increasing our general understanding of the basic processes of war at all levels. 4GW implies that as nation-states shift to newer derivation, chaotic forms of opposition will be encountered, which requires methods of fighting wars that effectively overcome these emerging non-state actors. The two theories CAS and 4GW provide much more than simply answers to old questions, but a rich array of new questions pertaining to operations on a modern battlefield. The U.S. military has already anticipated most of the optimal capabilities found in this study and is striving to learn how to optimally leverage these capabilities in the future visions of the future. The question remains if the military adapt quick enough to make it a reality and maintain relevance and dominance on the future battlefields.

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